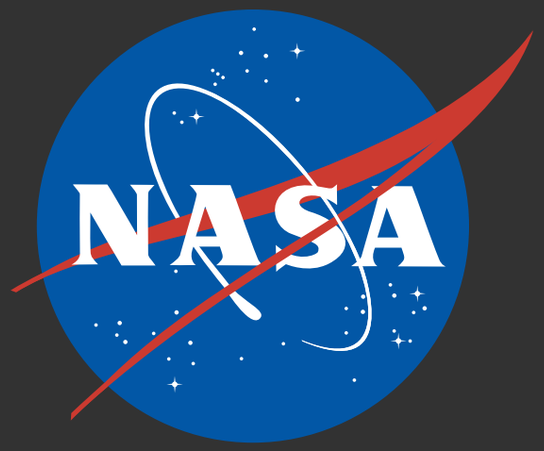
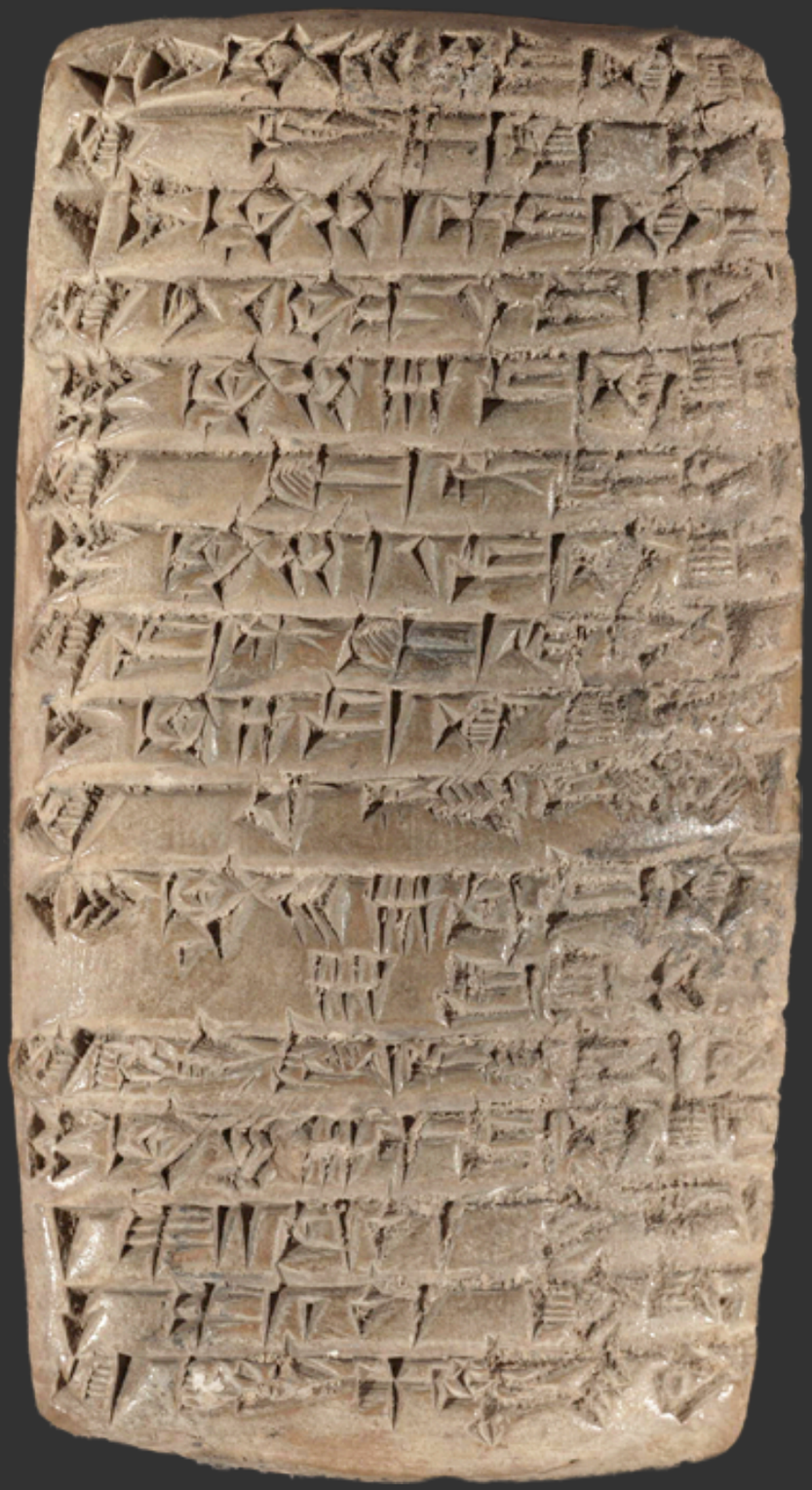
NASA Earth Observatory
Visualization Techniques from Design & Cartography



Robert Simmon
Science Systems and Applications, Inc.
under contract to NASA
robert.simmon@nasa.gov

History of Visualization



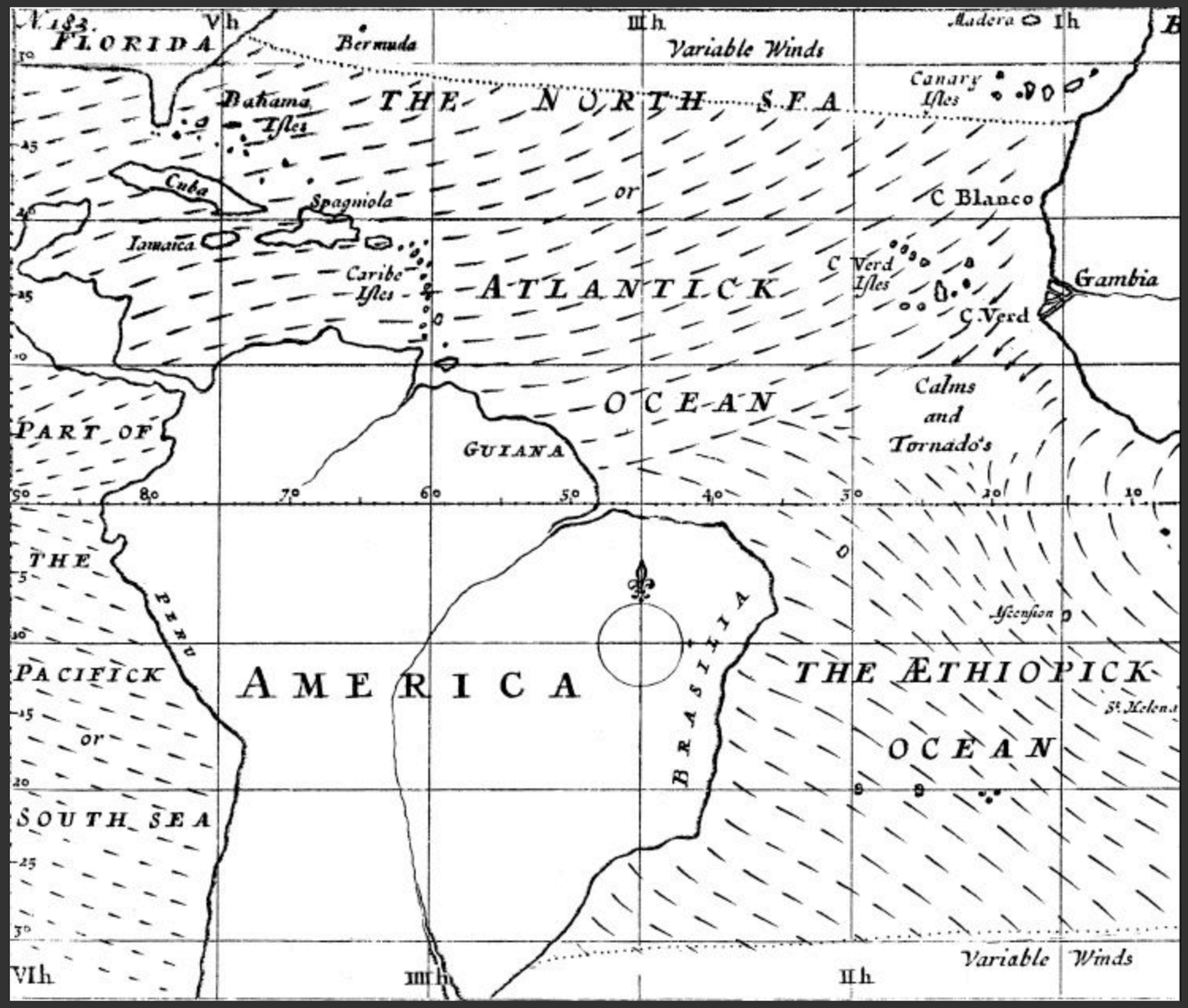
The earliest writing consists of pictograms: symbolic representations of real-world objects.

Cartography: Over 2,500 Years of Maps

Tabula Peutingeriana: a 12th Century Replica of a 5th Century map.

Thematic Maps: 1st Meteorological Map

Edmund Halley:
Map of the trade winds, published in 1686.



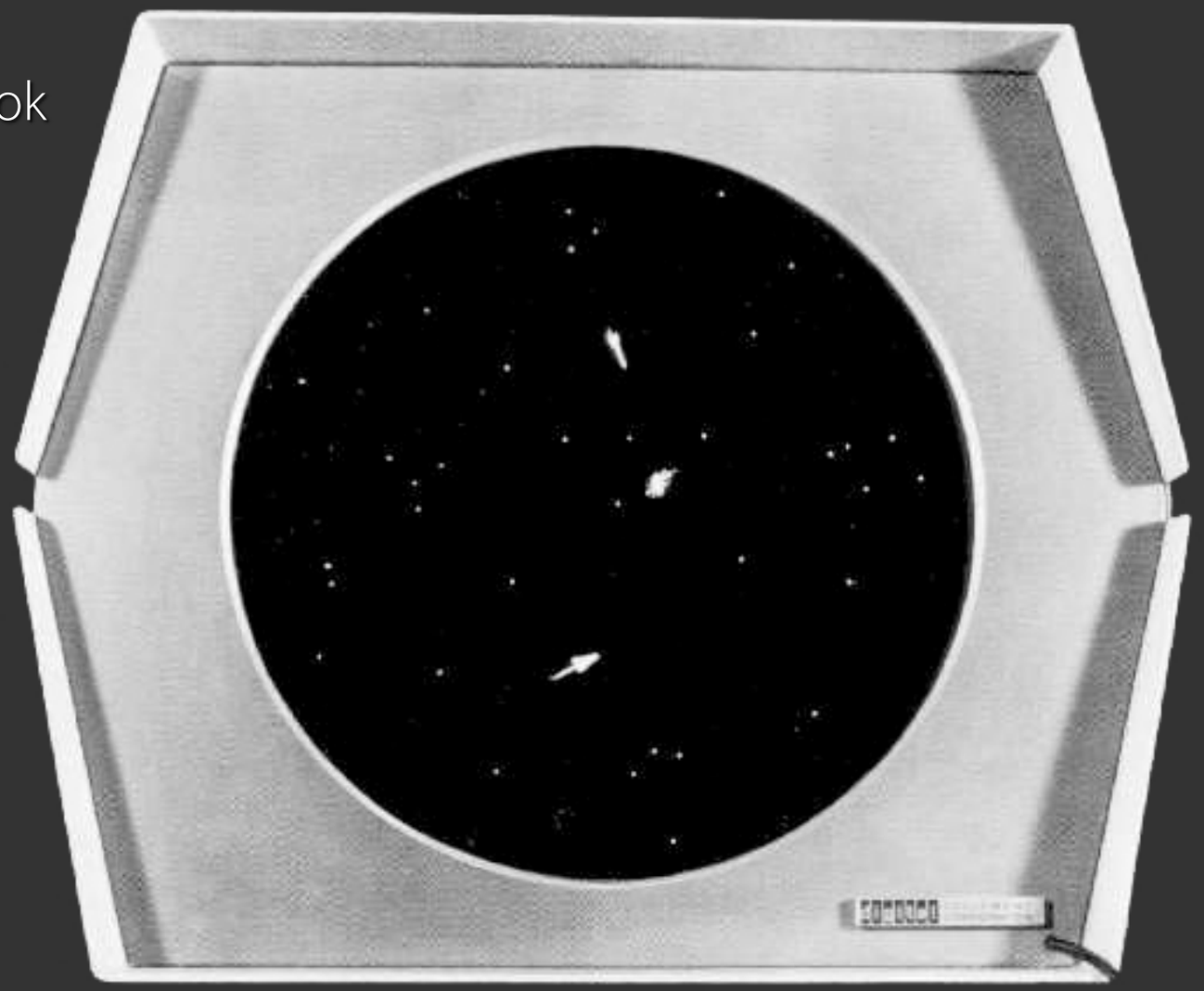
Thematic Maps: 1st Comprehensive Geological Map

William Smith, 1815.

CRATER LAKE NATIONAL PARK
Crater Lake
Rim Village
Cafeteria and Gift Shop
Sinnott Memorial Overlook
Rim Village Visitor Center (summer only)
Crater Lake Lodge
Visitor Information
Steel Information Center
Park Headquarters
Park Headquarters Historic Trail
Castle Crest Wildflower Trail
Mazama Village
Annie Spring Entrance Station
Godfrey Glen Trail
Annie Creek Canyon Trail
Cleetwood Trail
To tour boat landing
Cloudcap Overlook
Phantom Ship Overlook
Kerr Notch
Lost Creek
Pinnacles Overlook
Rim Drive
Pacific Crest National Scenic Trail
(hikers and stock allowed)
(hikers only)
No stock south of this point, hikers only
No stock north of this point, hikers only
Red Cone Spring
Sphagnum Bog
Fragile wetlands, no camping
Oasis Butte
Spruce Lake
Crater Creek
Bybee Creek
Lightning Spring
Discovery Point
Williams Crater
Hillman Peak
The Watchman
Devils Backbone
Merriam Point
North Junction
Llao Rock
Llao Bay
Steel Bay
Pumice Point
Palisade Point
Merriam Cone
Grotto Cove
Skell Head
Cloudcap Bay
Pumice Castle
Sentinel Rock
Danger Bay
Phantom Ship
Chaski Bay
Garfield Peak
Applegate Peak
Sun Notch
Dutton Cliff
Kerr Valley
Dutton Ridge
Vidae Falls
Grayback Drive
Grayback Ridge
Pinnacle Valley
The Pinnacles
Anderson Bluffs
Scott Bluffs
Sharp Peak
Bear Butte
Scout Hill
Mount Scott
Castle Point
Whitehorse Pond
Thousand Springs
Munson Point
Annie Spring
Duwee Falls
Arant Point
Quillwort Pond
Crater Peak
Rocktop Butte
Grouse Hill
Red Cone
Wineglass
Deepest point below lake surface: -1943ft -593m
Average surface elevation: 6173ft 1882m
Mount Scott (highest point in park) 8929ft 2721m

Computer Graphics

SpaceWar!
Slug Russell, Shag Graetz, & Alan Kotok
MIT, 1962



Information Design

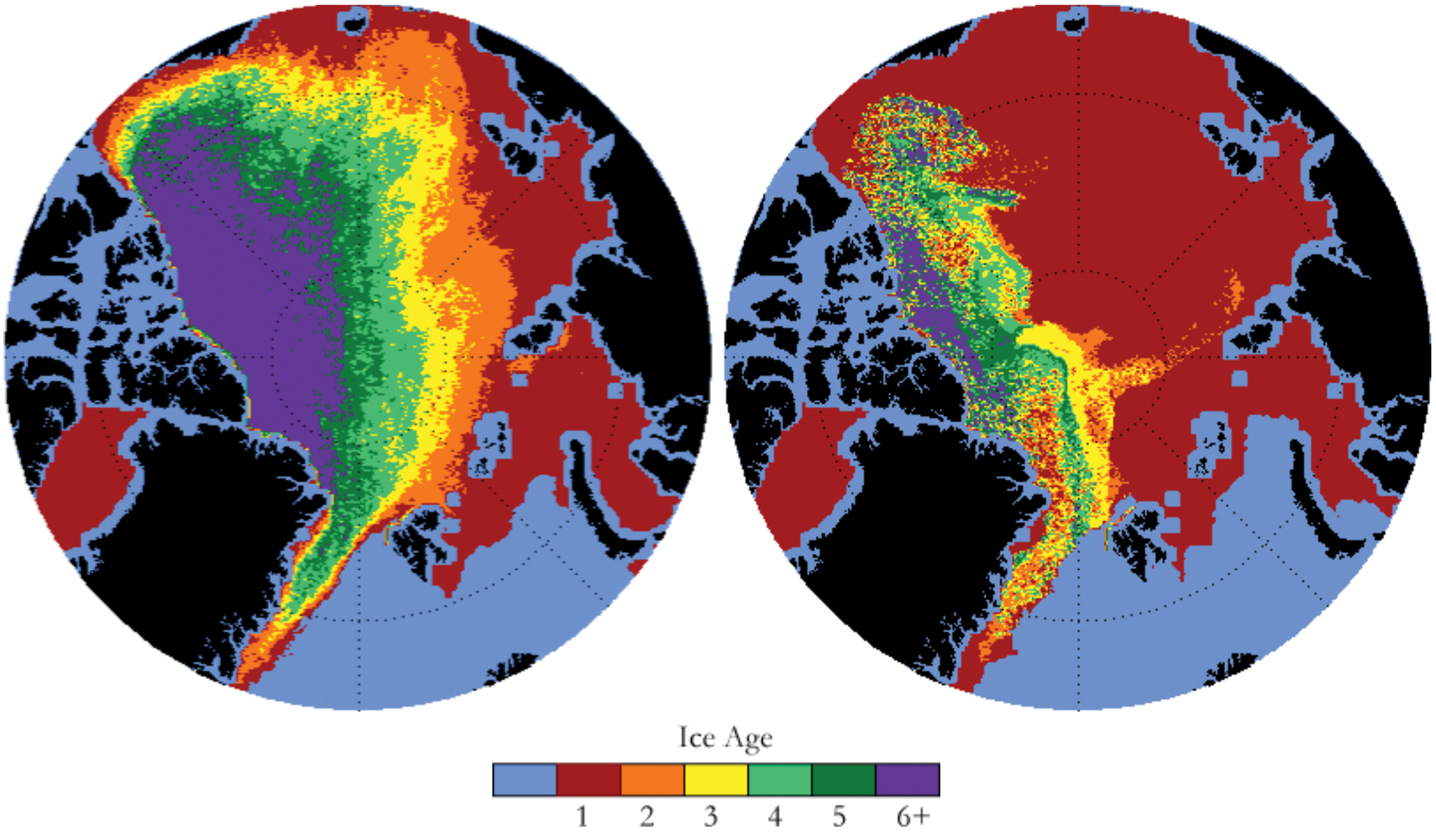
… addresses the organization and presentation of data: its transformation into valuable, meaningful information.

Nathan Shedroff

The art and science of preparing information so that it can be used by human beings with efficiency and effectiveness.

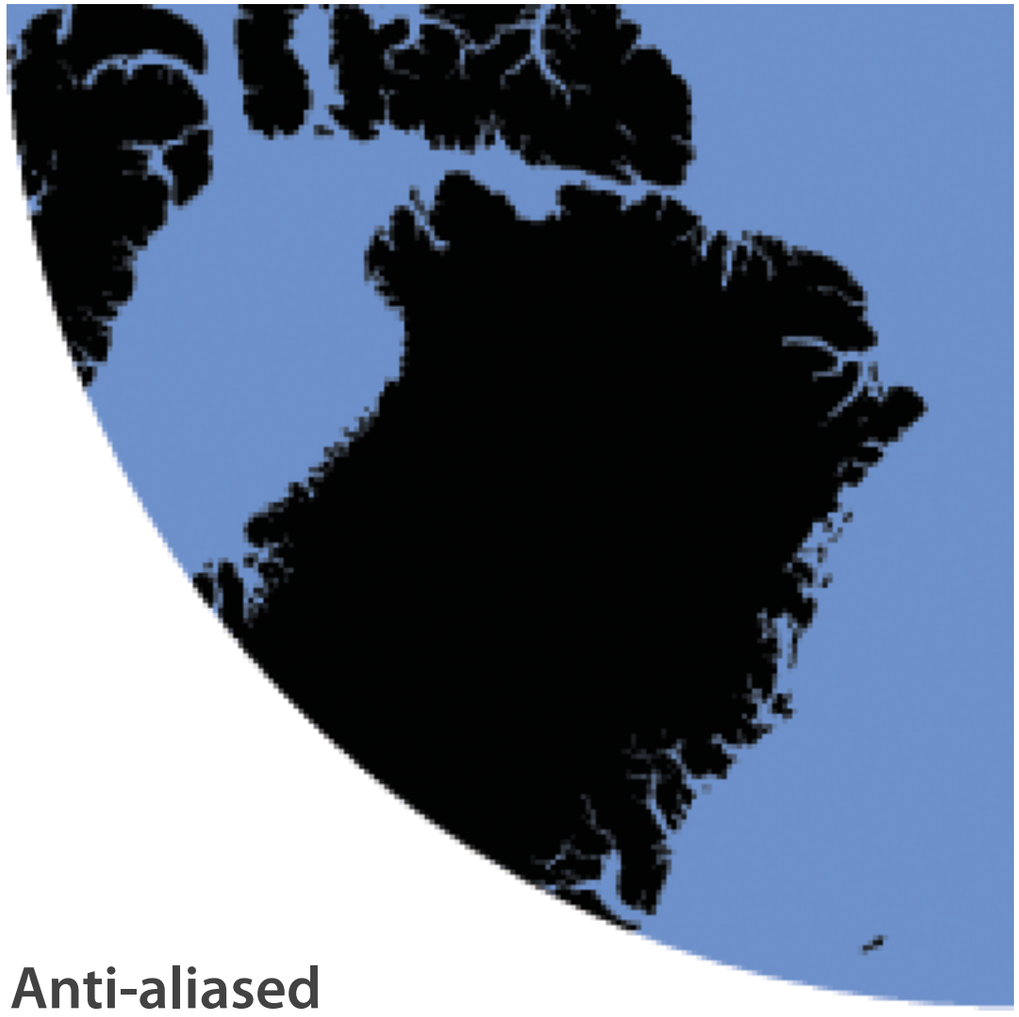
Robert E. Horn

Case Study: Sea Ice Age



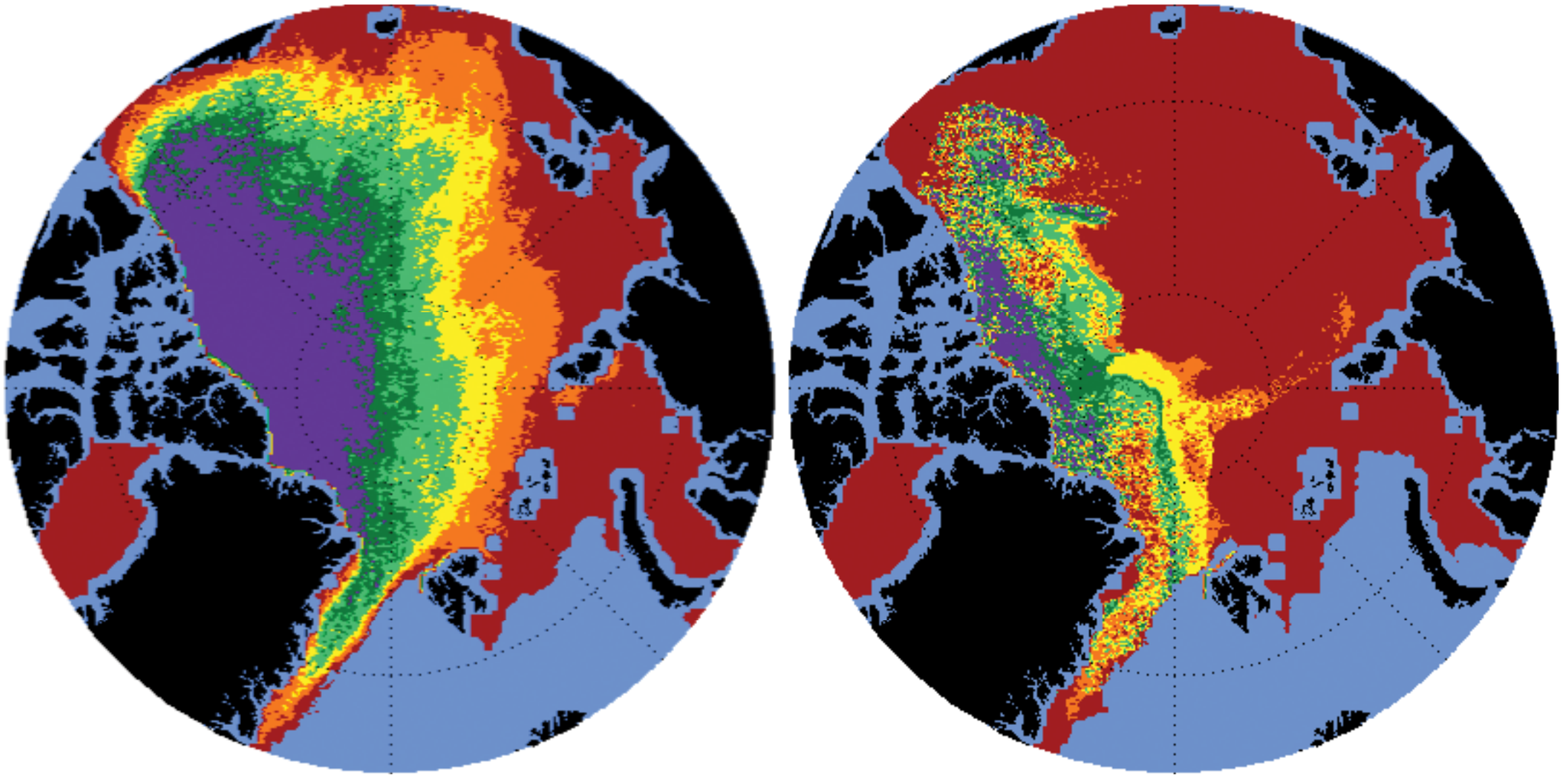
Anti-aliasing

Aliased



Anti-aliased

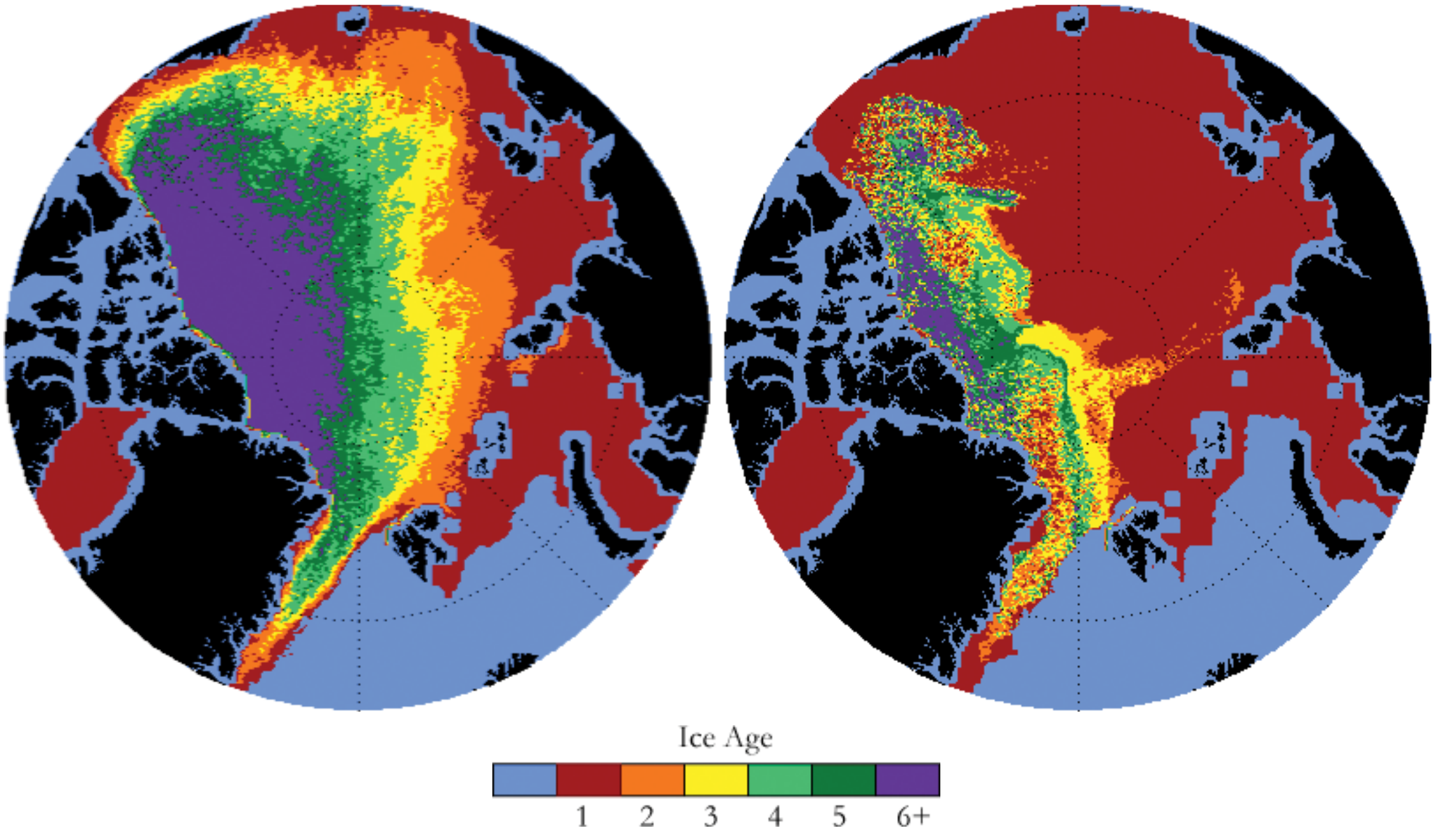
Figure-Ground



Areas of no data—open ice and land—
Are just as prominent as the ice-covered
areas, which de-emphasizes the content.

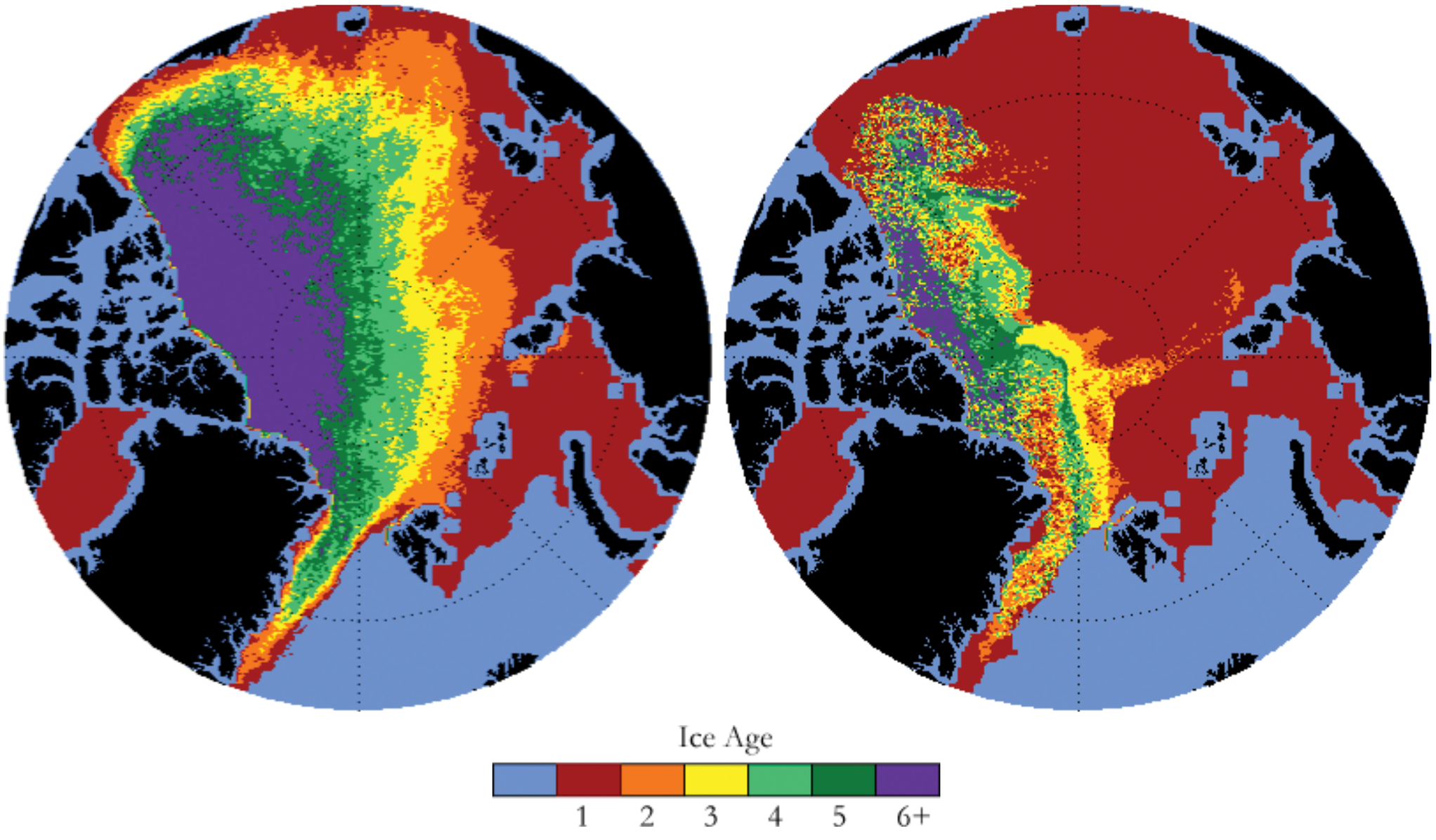
Figure-Ground

Case Study: Sea Ice Age

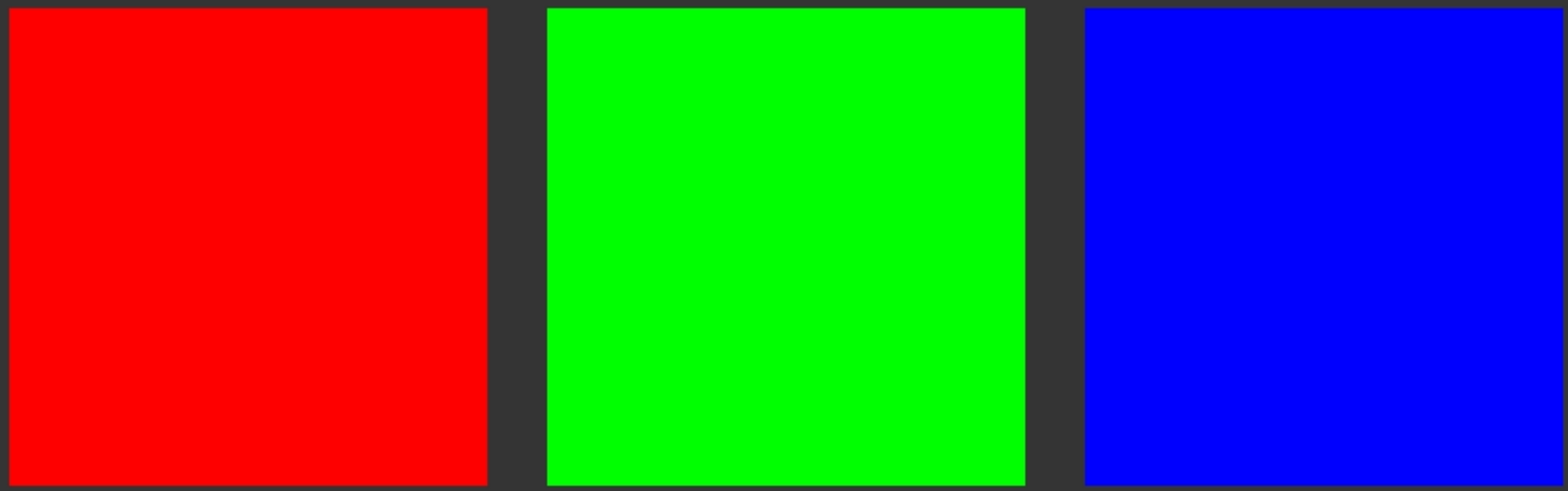


Rasterization

Case Study: Sea Ice Age

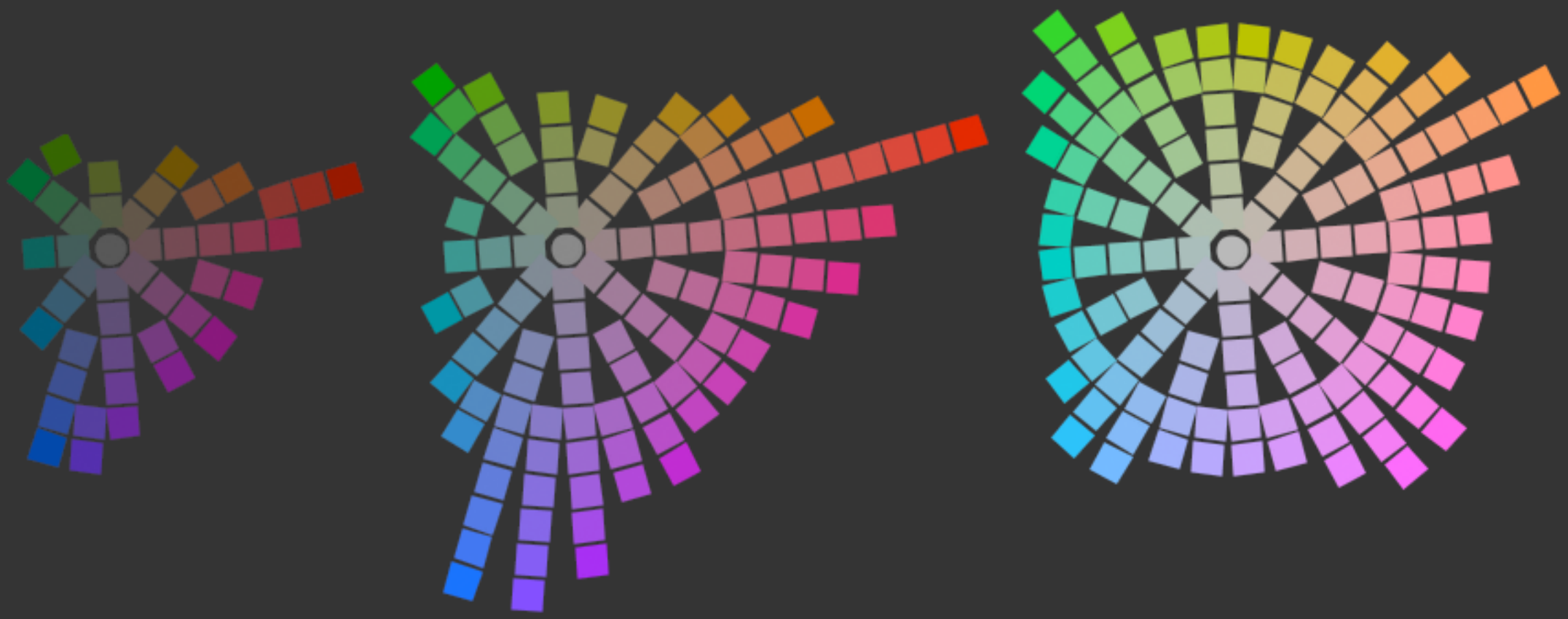


Color



Computer colors:
Red, Green, Blue; 0-255

Color

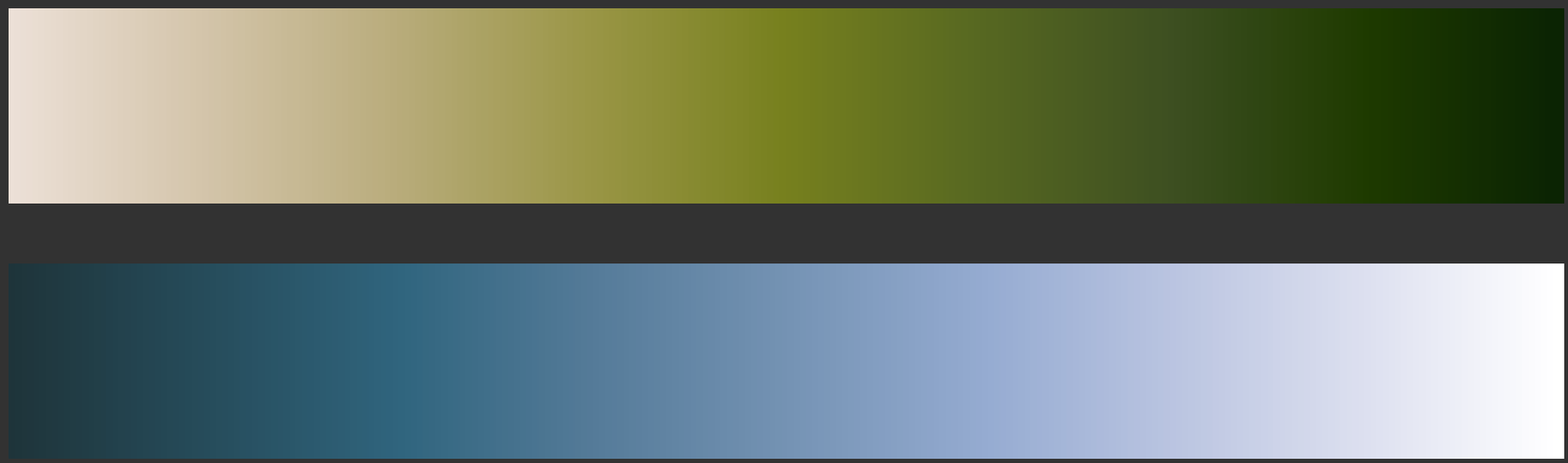


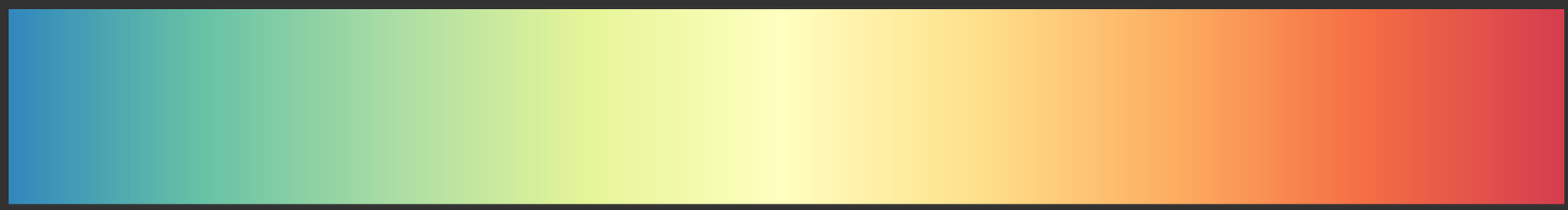
How humans see color: Chroma, Saturation, Lightness

To accurately represent color, palettes must account for human perception.

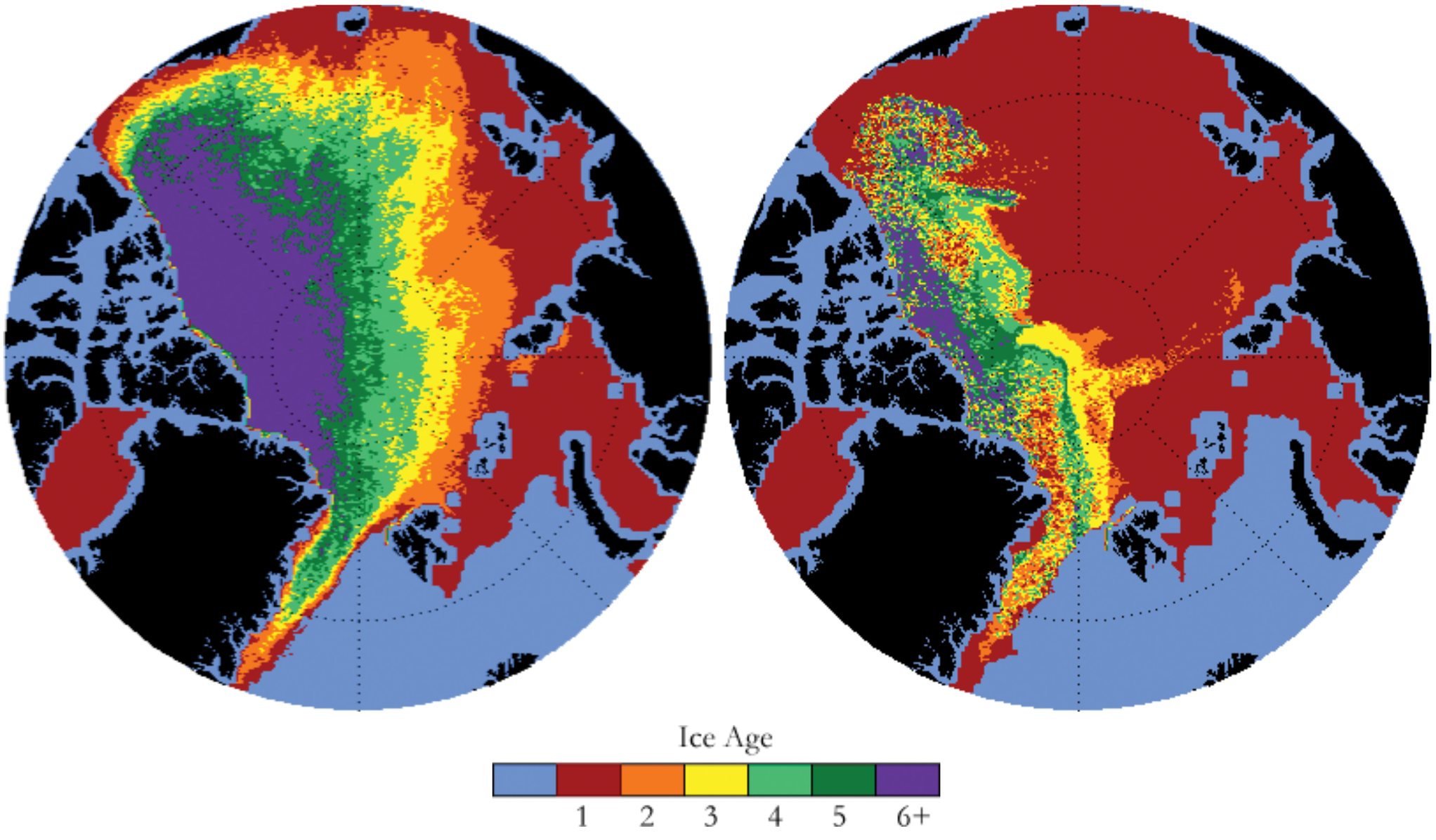
The Rainbow Palette

Perceptual Palettes

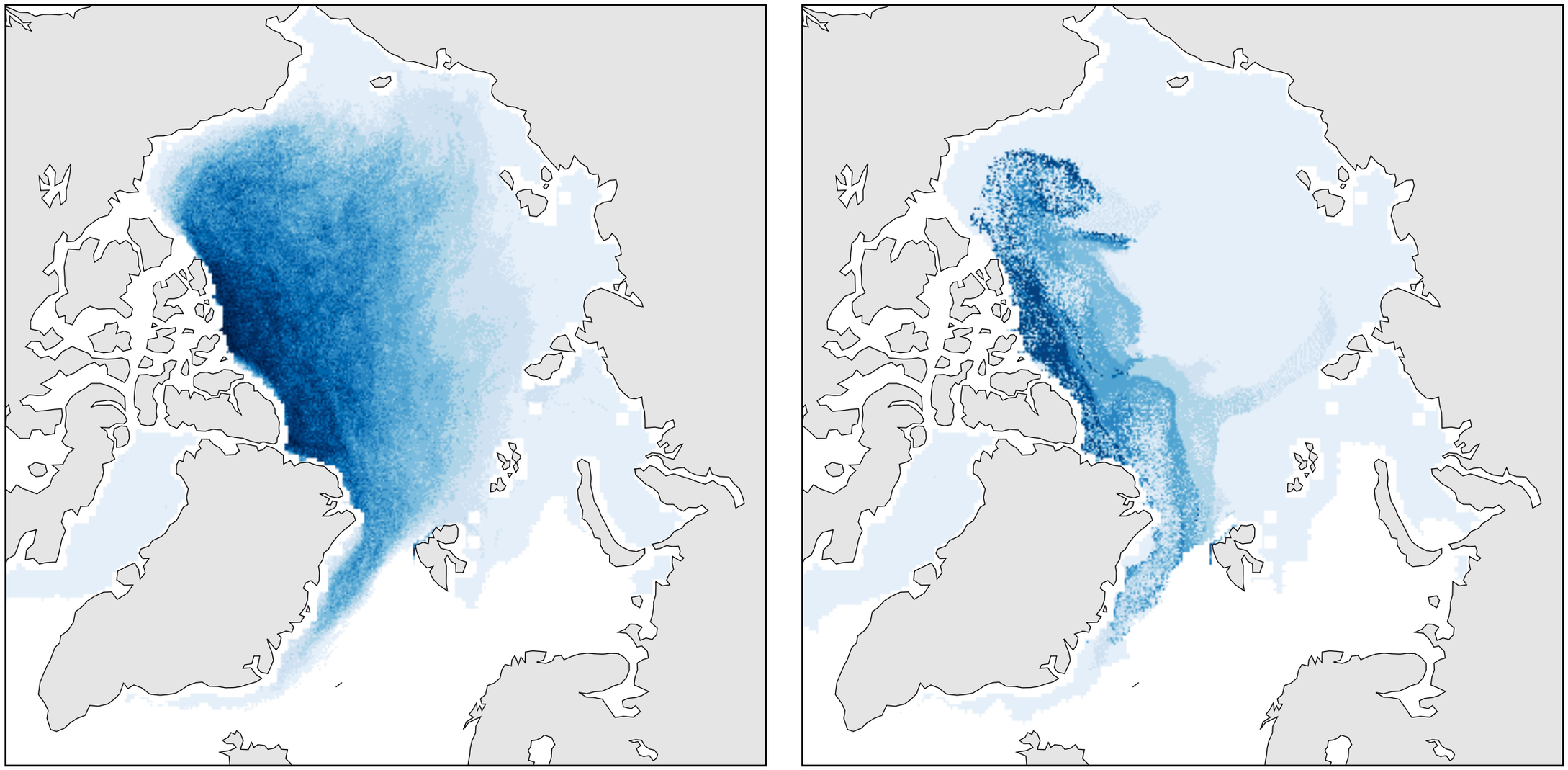




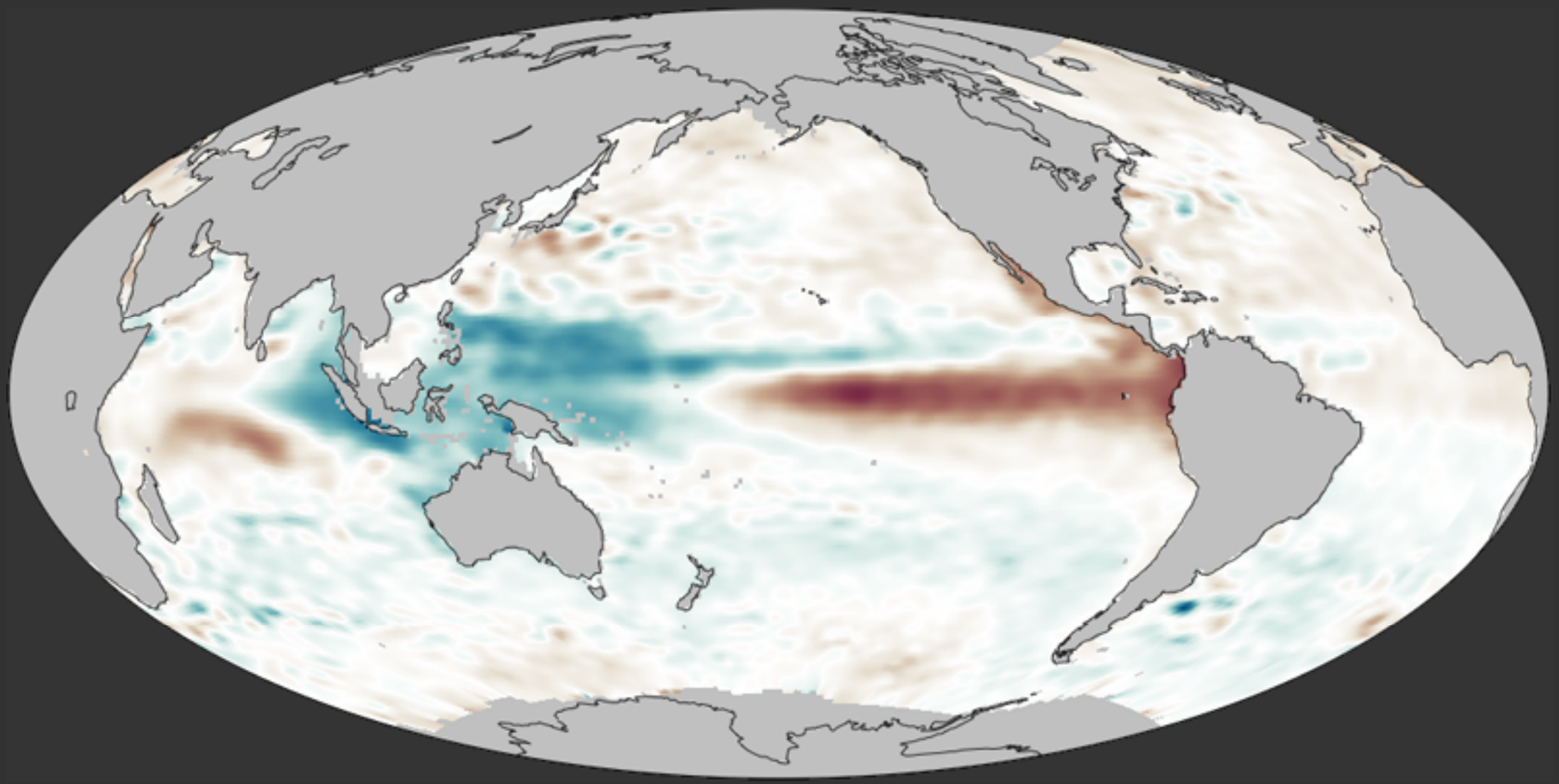
Case Study: Sea Ice Age



Case Study: Sea Ice Age



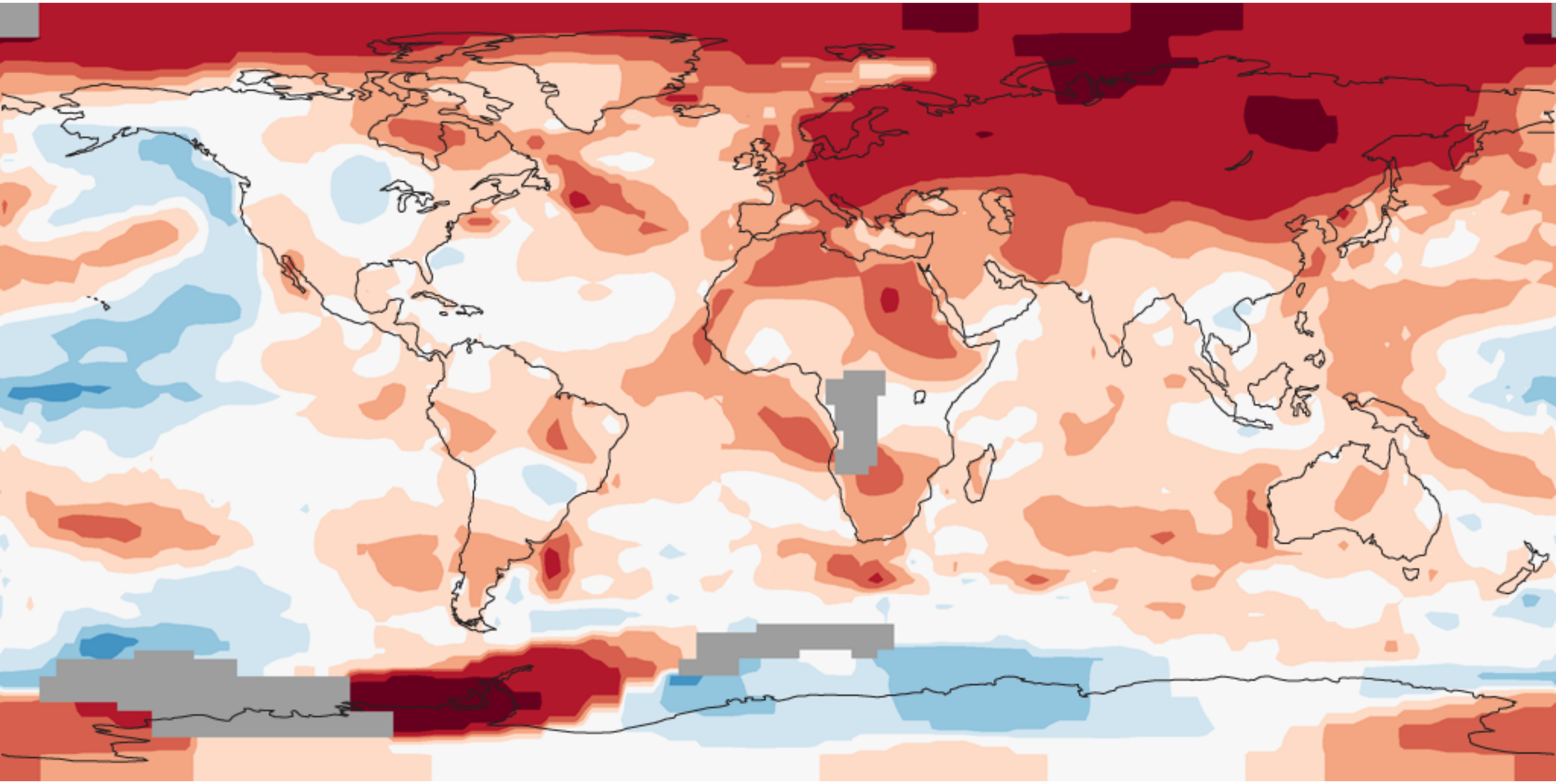
Divergent Palettes



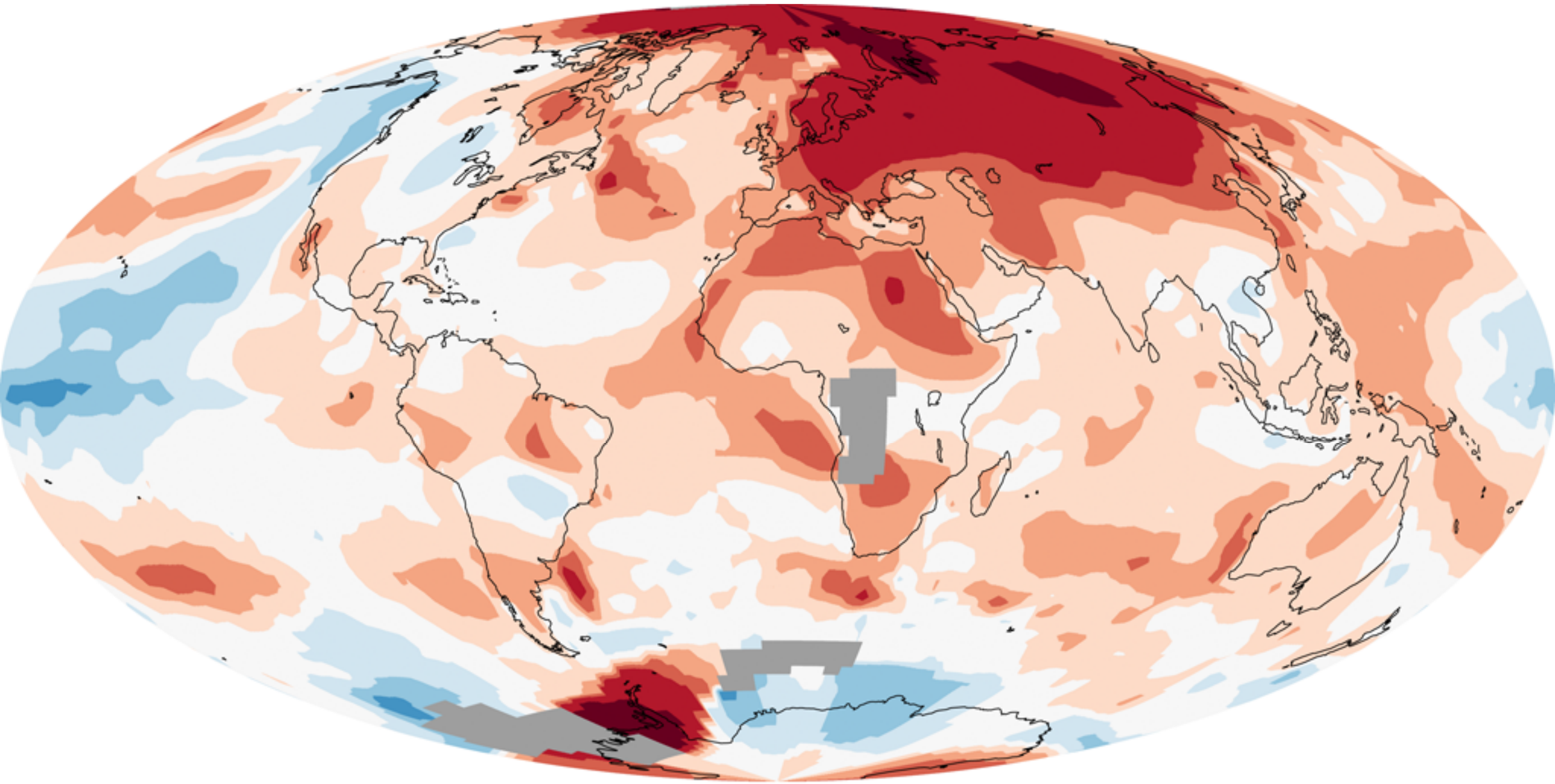
Sea Surface Height Anomaly (meters)

-0.4 -0.2 0 +0.2 +0.4

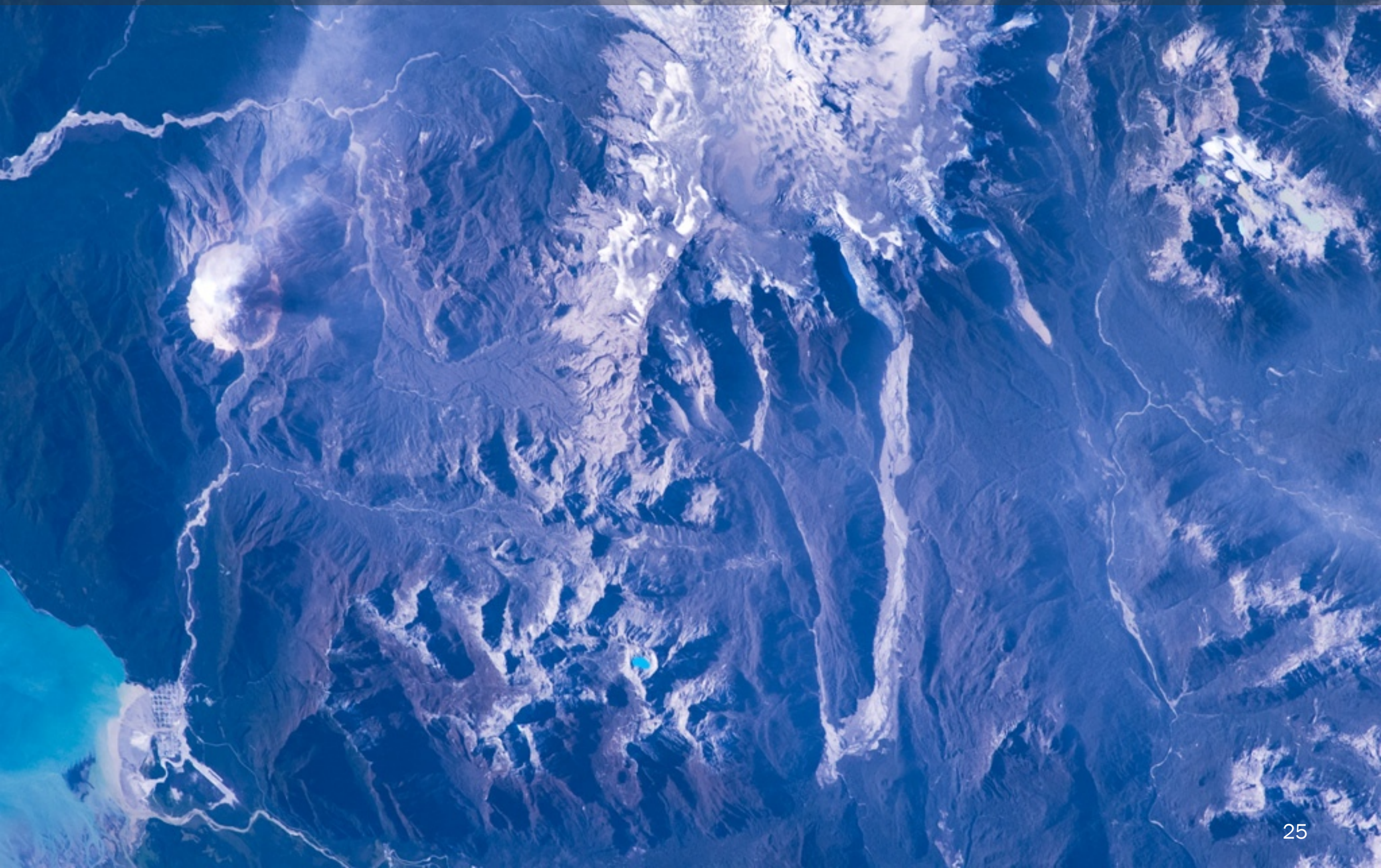
Map Projections



Map Projections



Color Correction: Original



Color Correction: Auto

Color Correction: Custom

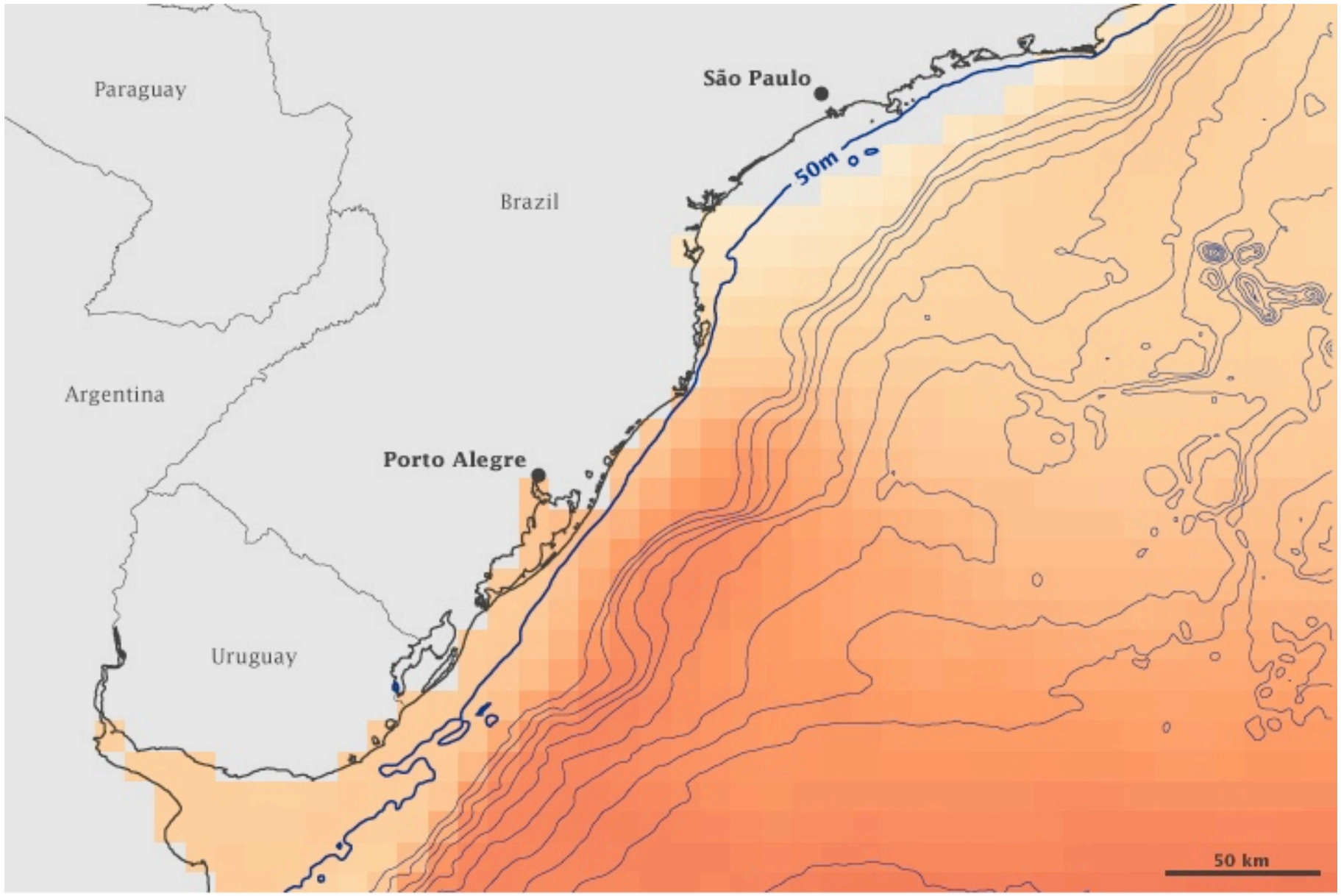
Typography: The Design of Text

Typography aids in the ordering and organization of information.
Use **font weight,** color, size, alignment,
& placement for emphasis, to group information, and to establish hierarchy.

Pairing one **serif** typeface and one **sans-serif** typeface together generally works well. Use one for headings and captions, the other for body text.

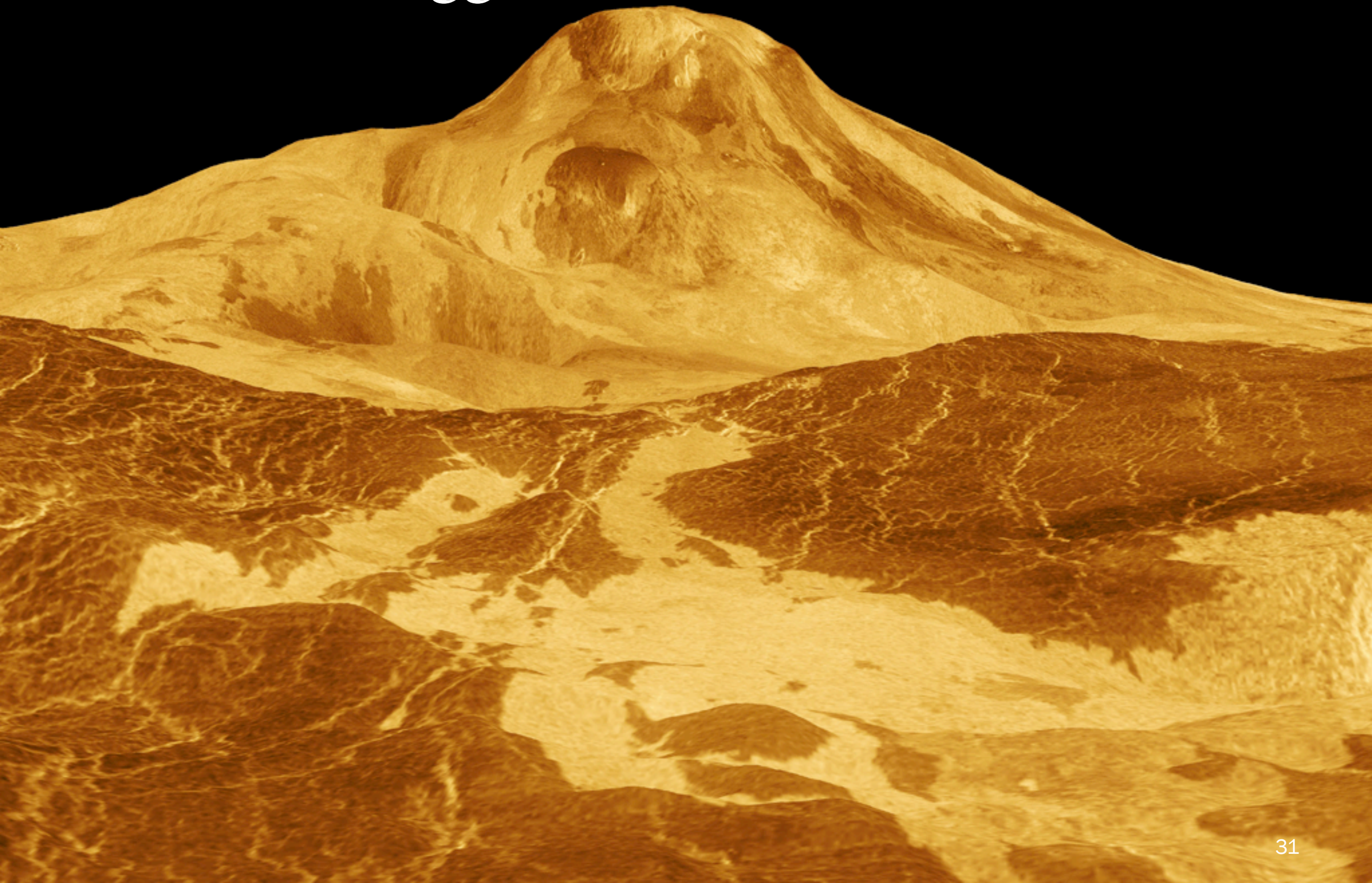
Avoid informal typefaces like **Comic Sans** and **Tekton,** as well as display typefaces like Papyrus, ***Brush Script,*** and COPPERPLATE GOTHIC.

Typography: The Design of Text

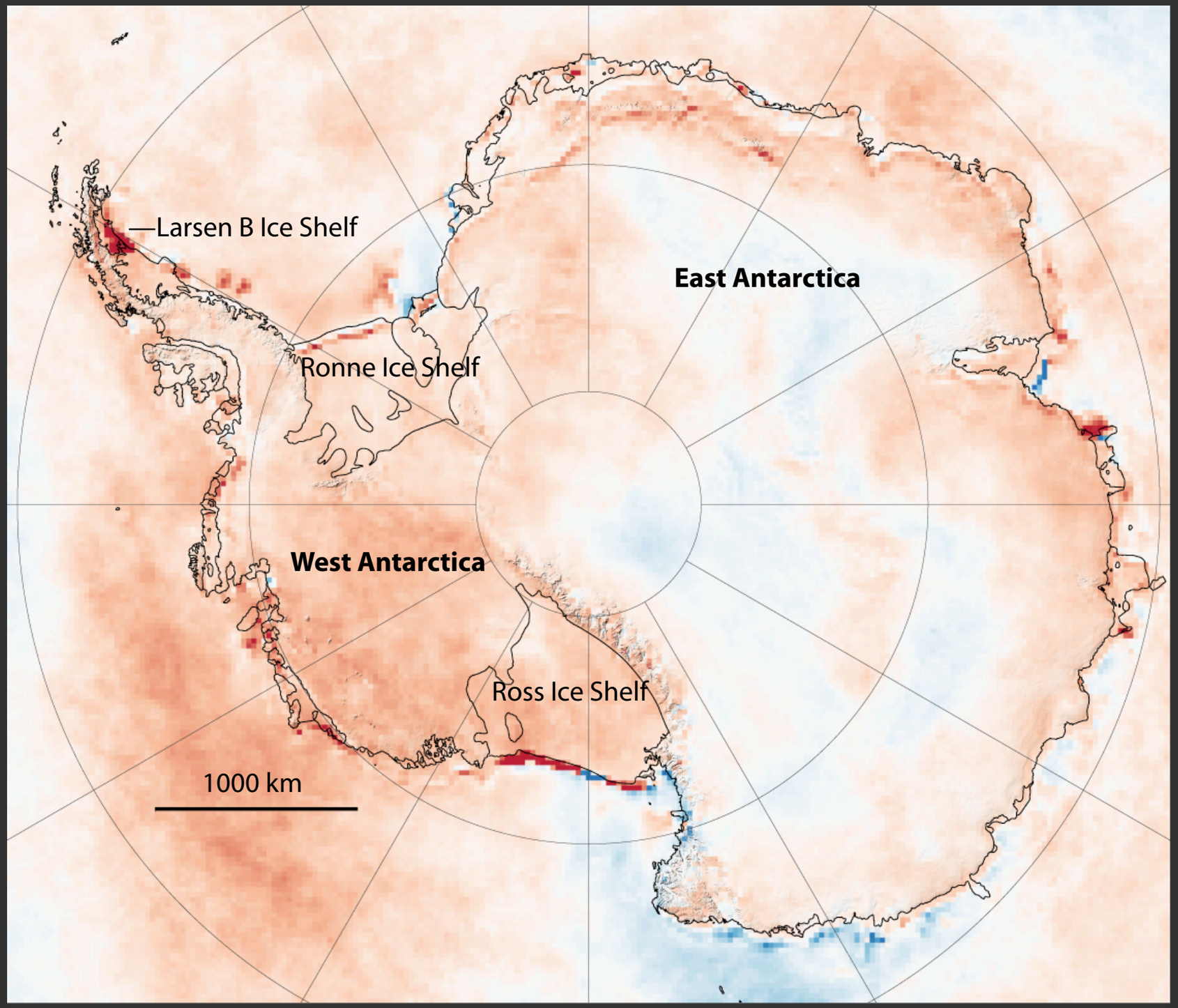


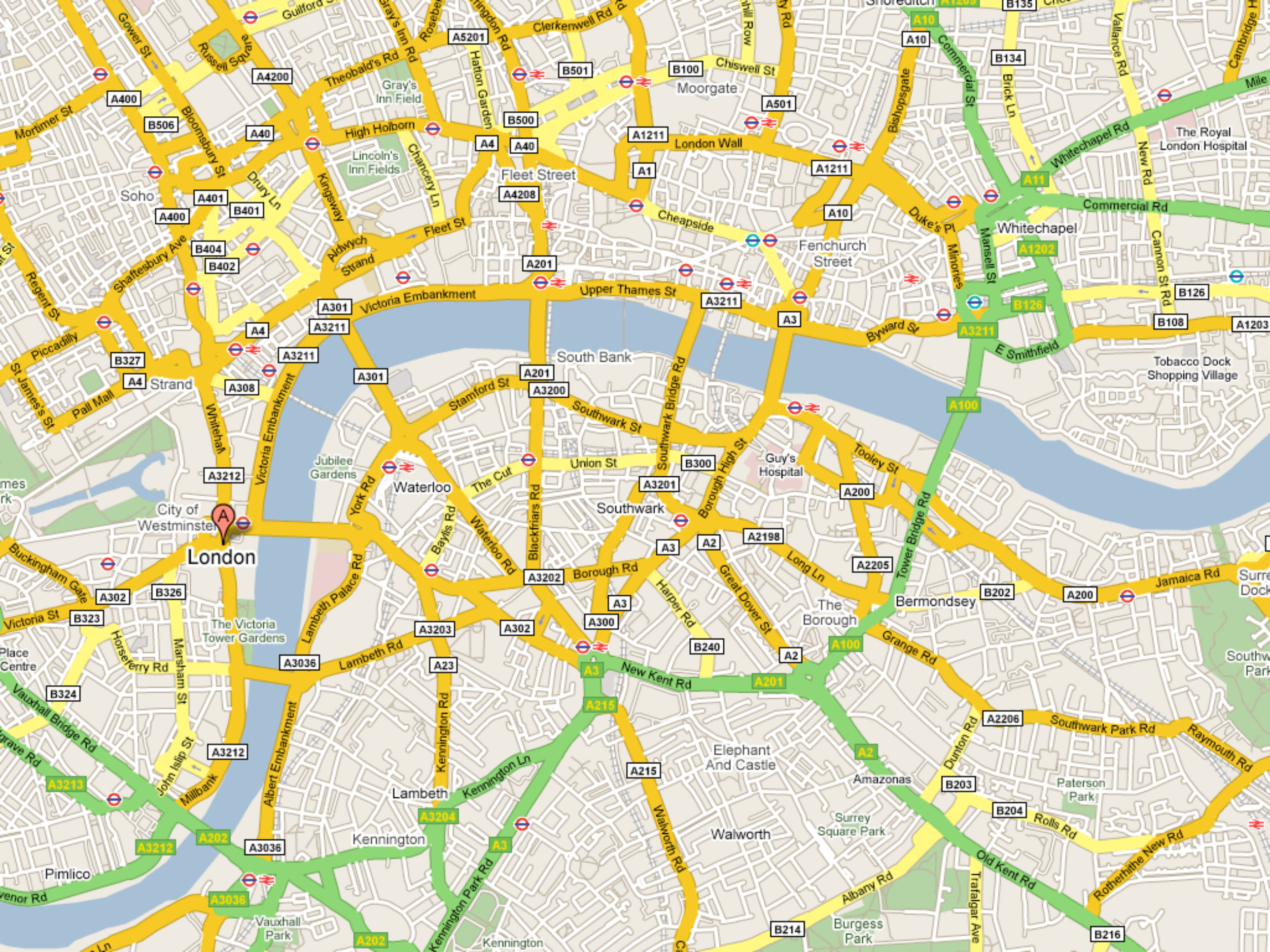
Design Techniques

Vertical Exaggeration



Design Techniques





London
City of Westminster
Soho
Strand
Fleet Street
Lincoln's Inn Fields
Gray's Inn Field
Moorgate
Fenchurch Street
Whitechapel
The Royal London Hospital
Commercial Rd
Cheapside
London Wall
Upper Thames St
Victoria Embankment
South Bank
Southwark
Waterloo
Jubilee Gardens
Guy's Hospital
Tobacco Dock Shopping Village
Bermondsey
The Borough
Elephant And Castle
Walworth
Amazonas
Surrey Square Park
Paterson Park
Burgess Park
Lambeth
Kennington
Vauxhall Park
Pimlico
The Victoria Tower Gardens
Buckingham Gate
Place Centre
Victoria St
Vauxhall Bridge Rd
Albert Embankment
Victoria Embankment
Lambeth Palace Rd
Lambeth Rd
Kennington Rd
Kennington Ln
Kennington Park Rd
Walworth Rd
Old Kent Rd
Rotherhithe New Rd
Southwark Park Rd
Raymouth Rd
Jamaica Rd
Grange Rd
Tower Bridge Rd
Tooley St
Borough High St
Southwark Bridge Rd
Blackfriars Rd
Waterloo Rd
Borough Rd
Great Dover St
Harper Rd
New Kent Rd
Long Ln
Albany Rd
Trafalgar Ave
Dunton Rd
Rolls Rd
Paul Mall
Piccadilly
St James's St
Regent St
Shaftesbury Ave
Whitehall
Millbank
John Islip St
Marsham St
Horseferry Rd
Venor Rd
Strand
Aldwych
Kingsway
Drury Ln
Fleet St
Chancery Ln
Gower St
Russell Square
Bloomsbury St
Mortimer St
Theobald's Rd
Guilford St
Gray's Inn Rd
Rosebery Rd
Clerkenwell Rd
Hatton Garden
Chiswell St
Moorgate
Bishopsgate
Commercial St
Brick Ln
Whitechapel Rd
New Rd
Cannon St Rd
Mansell St
Minories
Duke's Pl
Byward St
E Smithfield
Cambridge H
Vallance Rd
Mile
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B240
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B324
B326
B327
B402
B404
B500
B501
B506

until October 2006

ting Gate

Lancaster Gate

Bond Street

Oxford Circus

Goodge Street

Holborn

Chancery Lane

Moorgate

ueensway

sed until May 2006

Marble Arch

Tottenham Court Road

St. Paul's

Covent Garden

Bank

Aldgate

n Street sington

Hyde Park Corner

Green Park

Piccadilly Circus

Leicester Square

Cannon Street

Mansion House

Knightsbridge

Charing Cross

Open
Mondays - Fridays
until 2100 only
Saturdays 0730 - 1930

Monument

Tower Hill

Fenchurch Street 150m

cester oad

Sloane Square

St. James's Park

Blackfriars

River Th

Temple

London Bridge

South Kensington

Victoria

Westminster

Embankment

Charing Cross 100m

Berm

Waterloo

Waterloo & City line
Mondays - Fridays 0615 - 2130
Saturdays 0800 - 1830
Sundays closed

Waterloo & City line closed from April 2006 until September 2006

Pimlico

Southwark

Waterloo East

Borough

River Thames

Lambeth North

Vauxhall

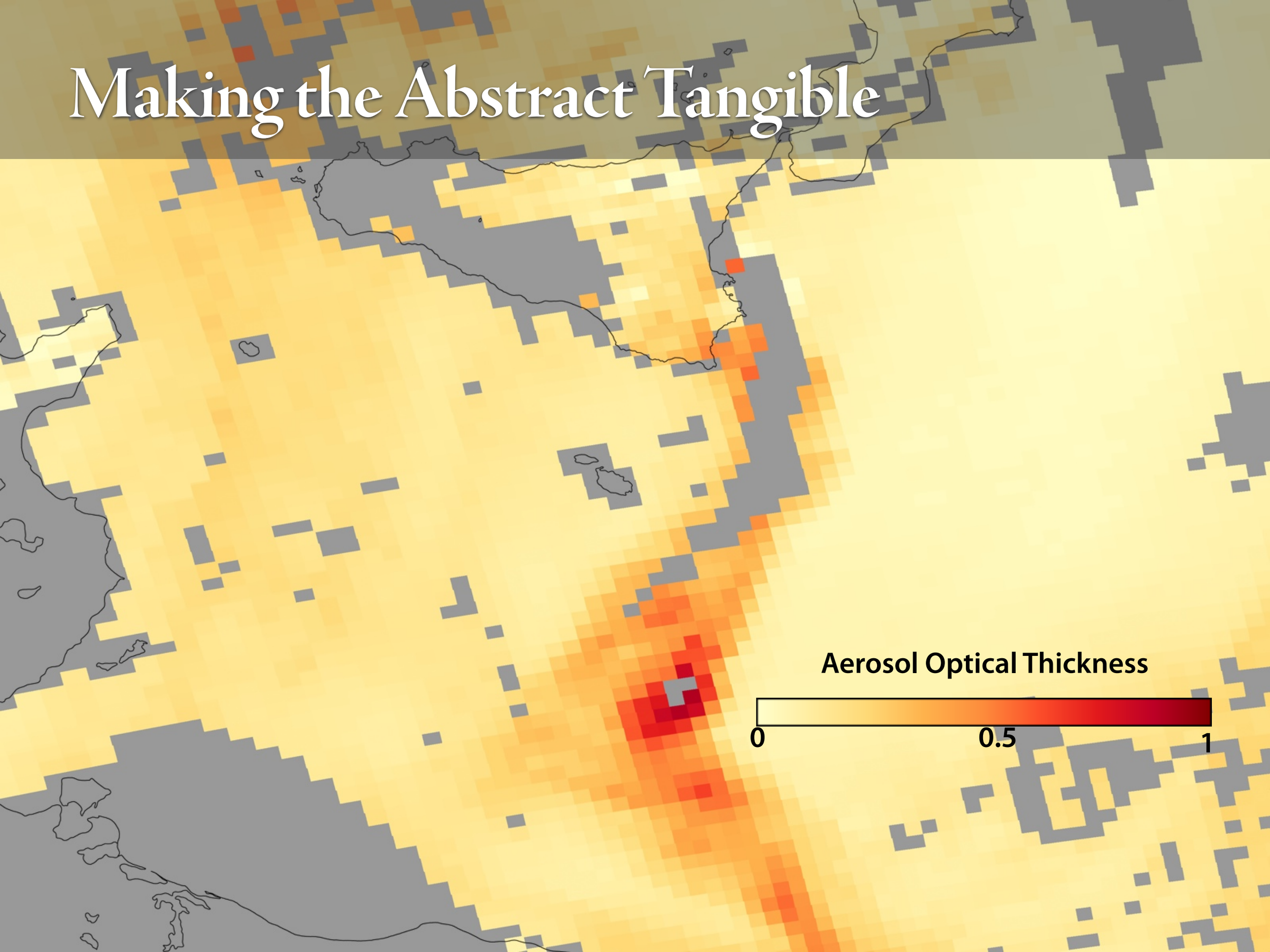
Kennington

Elephant & Castle

100m

At off-peak times most trains run to/from Morden via the Bank branch. To travel to/from the Charing Cross

Making the Abstract Tangible



Mt. Etna

October 30, 2002

Mt. Etna

Mt. Etna

October 30, 2002

Mt. Etna

October 31, 2002

Mt. Etna

October 30, 2002

Mt. Etna

October 30, 2002

Aerosol Optical Thickness

0 0.5 1